

## **Title: Sizing from Head to Toe**

### **Brief Overview:**

In this learning unit, students will collect data by measuring their height, foot length, and wrist and ankle circumference. Analysis of the data will include measures of central tendency and variation, graphical interpretation, and correlation.

### **Links to NCTM 2000 Standards:**

- **Mathematics as Problem Solving, Reasoning and Proof, Communication, Connections, and Representation**

These five process standards are threads that integrate throughout the unit, although they may not be specifically addressed in the unit. They emphasize a need to have students develop the processes that are the major means for doing mathematics, thinking about mathematics, understanding mathematics, and communicating mathematics.

Students will use statistical tools to analyze data and solve a real-world problem. They will demonstrate reasoning skills as they make predictions about behavior of variables. In addition, they will need to develop and present reasonable arguments in their written explanations of what their data tells them. Students will generate explanations in the writing component of the activity. They will use mathematical vocabulary throughout the writing. They also will make connections to geometry via the golden ratio extension activity and to business through the school store portion of the activity. Last of all, students will represent data in graphical, tabular, and equation form and use these representations to analyze data and draw conclusions.

- **Patterns, Functions, and Algebra**

Students will analyze and interpret graphical and tabular data. Students also will generate and analyze linear equations to model data and make predictions.

- **Measurement**

Students will determine appropriate axes scaling for given data sets.

- **Data Analysis, Statistics, and Probability**

Students will gather univariate data and study the relationship between variables. They will compute, identify, and interpret measures of central tendency and spread. Students will represent data using scatter plots.

### **Links to Virginia High School Mathematics Core Learning Units:**

- **A.5**

The student will analyze a given set of data for the existence of a pattern and represent the pattern algebraically and graphically.

- **A.17**

The student will, given a set of data points, write an equation for a line of best-fit and use the equation to make predictions.

- **A.18**

The student will compare multiple one-variable data sets using statistical techniques that include measures of central tendency, scatter plots, and histograms.

**Grade/Level:**

9<sup>th</sup> – 10<sup>th</sup>

**Duration/Length:**

Three 45 minute class periods

**Prerequisite Knowledge:**

Students should have working knowledge of the following skills:

- Measuring metric length
- Measures of central tendency
- Construction of scatter plots
- Understanding linear relationships
- Usage of the TI-83 graphing calculator statistics features
- Recognizing correlations between data

**Objectives:**

Students will be able to:

- take accurate measurements.
- use the graphing calculator to obtain measures of central tendency, create scatter plots, and find line of best fit .
- draw graphs.
- interpret graphs and analyze data.

**Materials/Resources/Printed Materials:**

- Tape measures
- TI-83 calculators/overhead projector
- Student data collection sheets
- Student Activity Sheets 1 - 3
- Teacher transparency of histograms
- One sheet of graph paper per student

### **Development/Procedures:**

1. Students will work in pairs within groups of four measuring and recording in centimeters height, foot length, wrist and ankle circumference on Student Data Sheet #1 and #2.
2. One student from each group will tape their group's data sheet to a designated place in the classroom. Another student from each group will then copy the other groups' data onto Student Data Sheet #2.
3. Each pair of students will enter data from Student Data Sheet #2 into TI-83 calculator. The lists should be named according to the corresponding data.
4. Students will perform one variable statistics ( 1-Var Stat ) on each list to obtain mean, median, and range. Mode will be found by sorting each list and counting.
5. Students will create the following scatter plots to determine relationships between measurements and to analyze and interpret data: a. foot length versus height; and b. wrist circumference versus ankle circumference.
6. Students will reproduce graphs on graph paper with appropriate labels and scales.
7. Students will complete Student Activity Sheets #1-#3.
8. Students will match teacher provided histograms of the four sets of data to the lists of data.
9. Teacher will create overhead transparency of histograms without scales and labels for use in matching activity.
10. For the wrist and ankle circumference histograms to be used in Student Activity Sheet #3, Problem #15, the widths of the bars of the histogram should correspond to sizes extra-small, small, medium, large, and extra-large. Suggested bracelet sizes are as follows: extra-small 14 cm and below; small 15-16 cm; medium 17-20 cm; large 21-22 cm; extra-large 23 cm and above. Suggested anklet sizes are as follows: extra-small 18 cm and below; small 19-22 cm; medium 23-28 cm; large 29-32 cm; extra-large 33 cm and above.

### **Assessment:**

The teacher will circulate around the classroom observing students to be sure they are on task and correctly executing the activity. Student worksheets will be collected and graded according to a rubric of the teacher's choice. The rubric should include a math and writing component.

### **Extension/Follow Up:**

1. Students will conduct research to find the average height of teenagers by decade for the past 100 years to determine if there is a trend.
2. Students will use linear regression to make other predictions (e.g., foot size for a given height).
3. Students will do more measurement activities to obtain the golden ratio.

**Authors:**

Barbara Goings  
Granby High School  
Norfolk, VA

Patricia A. Susla  
Woodstock Academy  
Woodstock, CT

Name\_\_\_\_\_ Period\_\_\_\_\_ Date\_\_\_\_\_

### STUDENT DATA SHEET #1

- Directions:**
1. Choose a partner within your group of four and measure and record in centimeters each other's height, foot length, wrist and ankle circumference.
  2. Copy the measurements from the other pair within your group into table.
  3. Copy the measurements for your group of four onto Student Data Sheet #2.
  4. Post Student Data Sheet #1 at designated location.

Name	Height	Foot Length	Wrist Circumference	Ankle Circumference
1.				
2.				
3.				
4.				
5.				

Name\_\_\_\_\_ Period\_\_\_\_\_ Date\_\_\_\_\_

## STUDENT DATA SHEET #2

**Directions:** Copy measurements from other groups into this table.

Name	Height	Foot Length	Wrist Circumference	Ankle Circumference
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				

17.				
18.				
19.				
20.				
21.				
22.				
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				
31.				
32.				

Name\_\_\_\_\_ Period\_\_\_\_\_ Date\_\_\_\_\_

## STUDENT ACTIVITY SHEET #1

### Directions:

1. Each pair should create named lists from the home screen, as follows:  
<STAT SET UP EDITOR>  
Type in names HGHT, FOOT, WRST, ANKL  
Hit ENTER (Calculator will say “Done”)
2. Each pair should enter the data from Student Data Sheet #2 into named lists <STAT EDIT> as follows:  
Height into list named HGHT (L1)  
Foot Length into list named FOOT (L2)  
Wrist circumference into list named WRST (L3)  
Ankle circumference into list named ANKL (L4)
3. Each pair should perform 1-Var Stats <STAT CALC> followed by list name <2<sup>nd</sup> LIST> on each list to obtain the following: mean; median; and range.  
Record statistics in table.
4. Each pair should copy named lists into L1, L2, L3, and L4 as follows:  
<STAT SET UP EDITOR> enter <STAT EDIT>  
Cursor on L1 <2<sup>nd</sup> LIST>  
Arrow down to name of list  
Repeat until all lists are copied
5. Each pair should sort each copied list to find the mode <STAT> SORTA (L1) Repeat for L2, L3, and L4. Record modes in the table.

	Height	Foot Length	Wrist Circumference	Ankle Circumference
Mean				
Median				
Range				
Mode				



Name\_\_\_\_\_ Period\_\_\_\_\_ Date\_\_\_\_\_

## STUDENT ACTIVITY SHEET #2

1. What is the average height of the students in your class?
2. What is the average foot length of the students in your class?
3. How does your height compare to the class average?
4. Find the percent difference of your height to the class average.

$$\frac{|\text{Your height} - \text{Class Average}|}{\text{Class Average}}$$

5. Is your foot length in the upper or lower 50% of the class? Explain your answer.
6. What is the most common shoe size? Explain your answer.

Name\_\_\_\_\_ Period\_\_\_\_\_ Date\_\_\_\_\_

## **MATCHING ACTIVITY**

**Directions:** Match the histograms on the overhead projector to the appropriate data list.

**Histogram**

**Data List**

**A**

\_\_\_\_\_

**B**

\_\_\_\_\_

**C**

\_\_\_\_\_

**D**

\_\_\_\_\_

Name \_\_\_\_\_ Period \_\_\_\_\_ Date \_\_\_\_\_

### STUDENT ACTIVITY SHEET #3

1. Using the TI-83, create a scatter plot of foot length (on horizontal axis) versus height (on vertical axis) <2<sup>ND</sup> STAT PLOT>.
2. Draw the scatter plot on graph paper using appropriate labels and scales.
3. What is the foot length of the shortest student? \_\_\_\_\_
4. Give the coordinates of this point. ( \_\_\_\_\_, \_\_\_\_\_ )
5. Label this point with an S on the graph paper.
6. Write a complete sentence explaining the meaning of this coordinate.
7. Is this the student with the shortest foot length? \_\_\_\_\_ Explain your answer.
8. What is the foot length of the tallest student? \_\_\_\_\_
9. Give the coordinates of this point. ( \_\_\_\_\_, \_\_\_\_\_ )
10. Label this point with a T on the graph paper.
11. Write a complete sentence explaining the meaning of this coordinate.
12. Is this the person with the longest foot length? \_\_\_\_\_ Explain your answer.

13. Is there a relationship between foot length and height? \_\_\_\_\_ Explain your answer.
14. What is the correlation on your scatter plot? (Be sure diagnostics are on <2<sup>nd</sup> CATALOG>. Arrow down to DIAGNOSTICS, hit enter twice.)
15. Based on a study conducted earlier, the school store has decided to sell anklets and bracelets. The school store has asked this class to use its data to determine the number of each size anklet and bracelet to purchase. Given the number of students in your school and the histograms for wrist and ankle circumference, determine how many of each size should be purchased. Show Work.
16. Write a letter to the school store manager explaining how many of each type should be purchased and why.
17. Find the line of best fit for wrist versus ankle circumference.  
<STAT CALC> Choose LinReg (ax + b) L3, L4
18. Use your regression equation to predict the ankle circumference of a person whose wrist circumference is 25 centimeters. Show work..

## SIZING FROM HEAD TO TOE SCORING RUBRIC

Each student activity is assigned a maximum number of points as shown below:

Activity Sheet #1	25 points, all from math indicators
Activity Sheet #2	10 points, 5 from math indicators 5 from writing indicators
Matching Activity	5 points, all from math indicators
Activity Sheet #3,	60 points, 40 from math indicators 20 from writing indicators

The following rubrics will be used by the teacher to determine the number of points awarded:

### MATH INDICATORS

Place a number of points in the appropriate box for each activity.

	Activity Sheet #1	Activity Sheet #2	Matching Activity	Activity Sheet #3
Solution is complete and correct. There are no errors in notation or computation.				
Solution is complete and almost correct, but contains an occasional minor error in notation or computation.				
Solution is complete and conceptually correct, but contains numerous errors in notation or computation.				
Student shows some understanding of the concepts. Student does not complete the solution or completes the solution with some conceptual errors.				
Student made a minimal attempt. Some computational work is correct, but there is a clear misunderstanding of the concepts involved.				
Work is all wrong or meaningless. No correct mathematics is used for a solution.				
<b>TOTAL MATH SCORE</b>				

### COMMENTS:

Student's Name \_\_\_\_\_

Date: \_\_\_\_\_

## WRITING INDICATORS

Place a number of points in the appropriate box for each activity.

<b>Content and Organization Indicators</b>	<b>Activity Sheet #2</b>	<b>Activity Sheet #3</b>
• Writing is clear and well organized.		
• Writing is concise.		
• Writing is complete.		
• Writer has identified the necessary information.		
• Writer shows correct mathematical terminology.		
• Writer shows the ability to make mathematical connections.		
• Writer shows an understanding of mathematical concepts.		
<b>Mechanics Indicators</b>		
• Spelling is correct.		
• Writer uses correct punctuation.		
• Grammar is correct.		
• Writing is neat and legible.		
<b>TOTAL WRITING SCORE</b>		

### COMMENTS:

Student's Name \_\_\_\_\_

Date: \_\_\_\_\_